



Barrier Island Habitat: Sea-level rise and storms

Ben Gutierrez

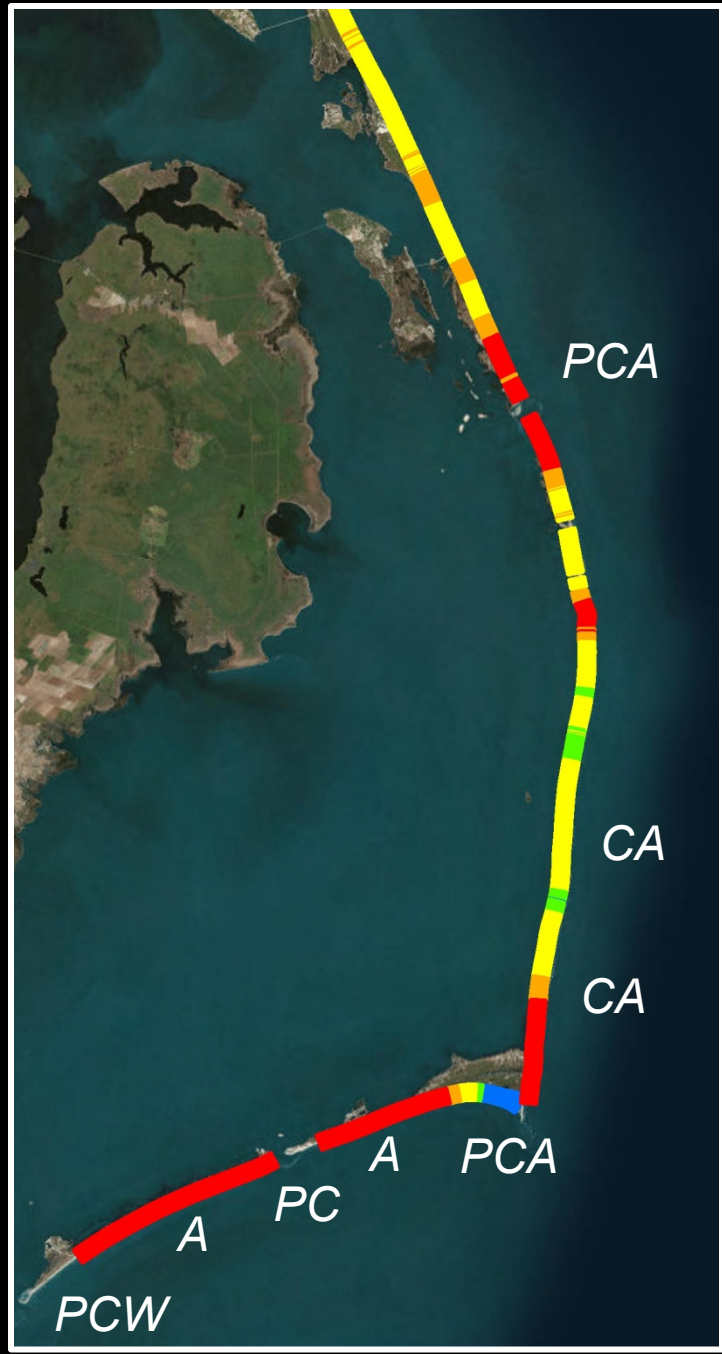
**U.S. Geological Survey Coastal and Marine
Geology Program**

**Acknowledgements: Rob Thieler, Sara
Zeigler, Nathaniel Plant, Hilary Stockdon**

Question 12:

- a. What are the dynamics of barrier islands, storm dynamics, sea-level rise, etc. as they relate to the multiplicity and complexities of all the critical barrier island habitats?**
- b. What modifications are resulting from the presence of tens of thousands of people living near the Seashore?**
- c. How is the related infrastructure dictating the geomorphic and biologic response?**

Cape Hatteras Shoreline Change Rates

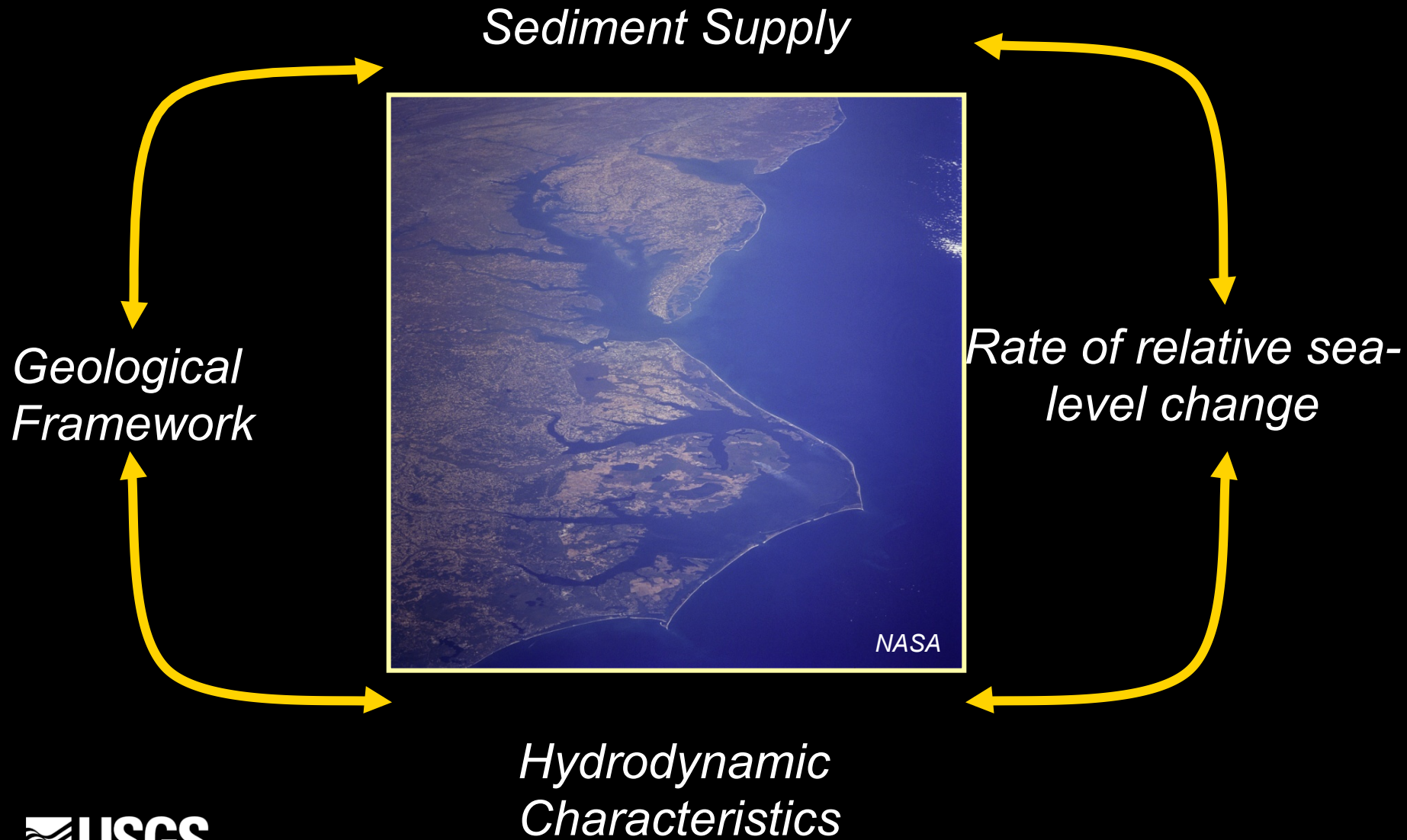


P = PiPL
C = CWB
A = AMOY
W = WiPL

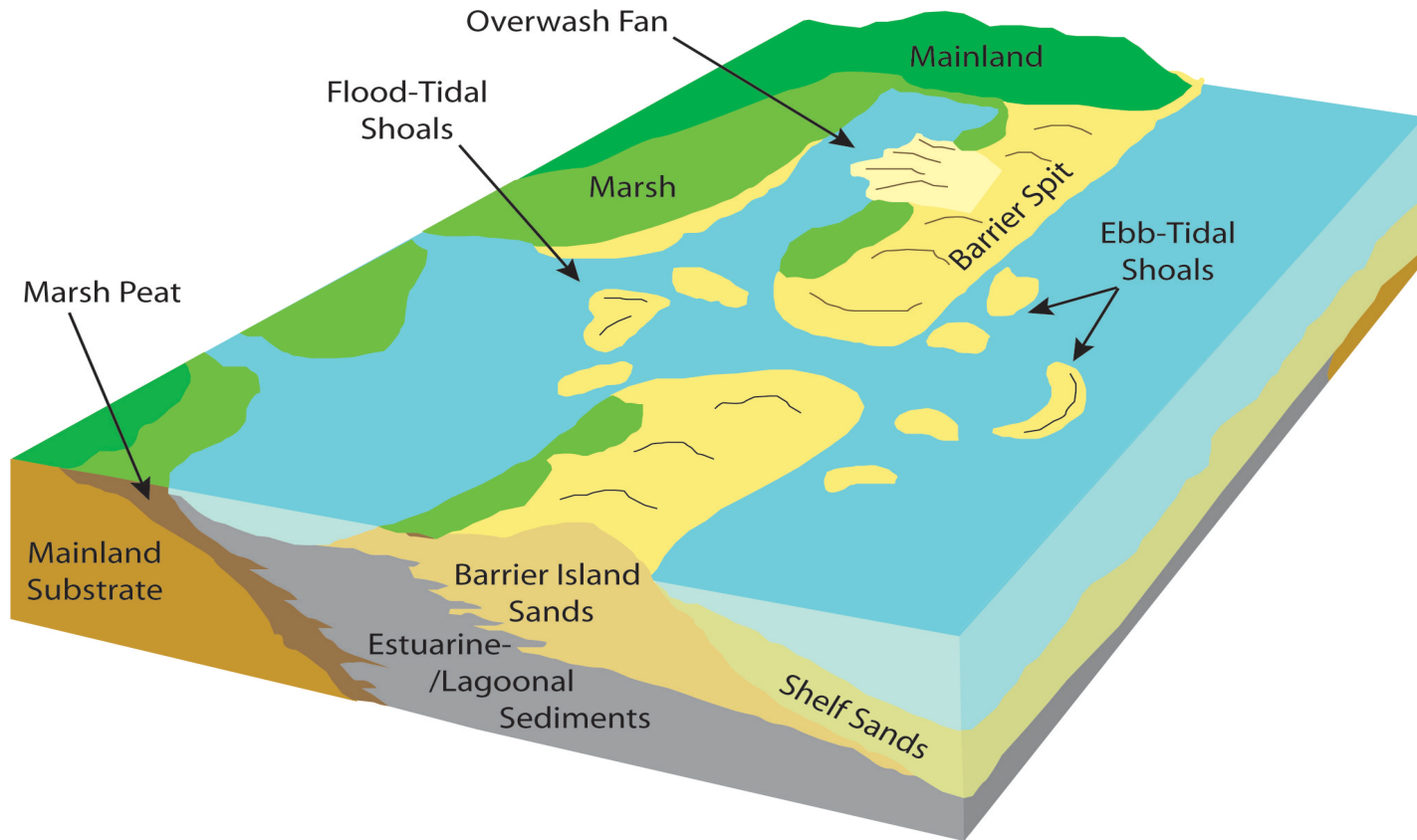
Turtles not
shown



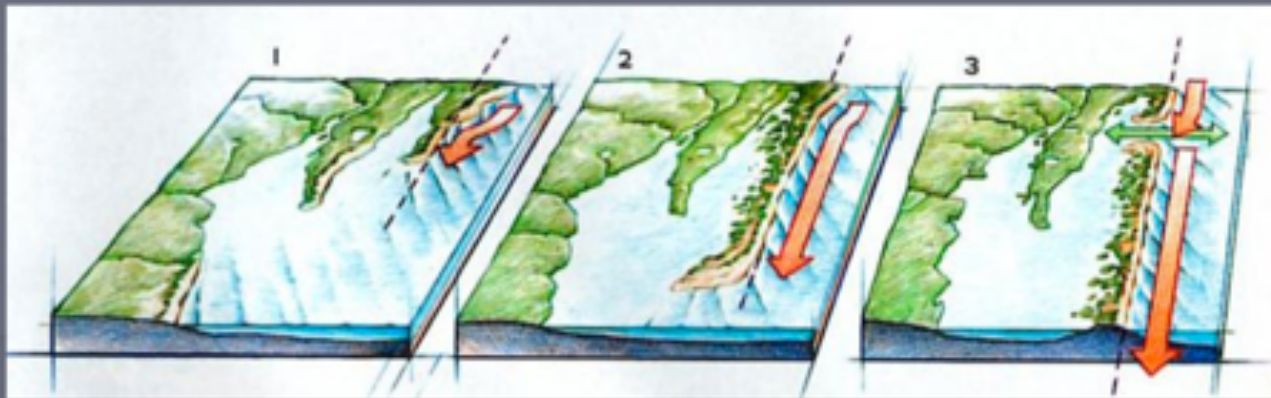
Factors Influencing Coastal Evolution



Barrier Island Components



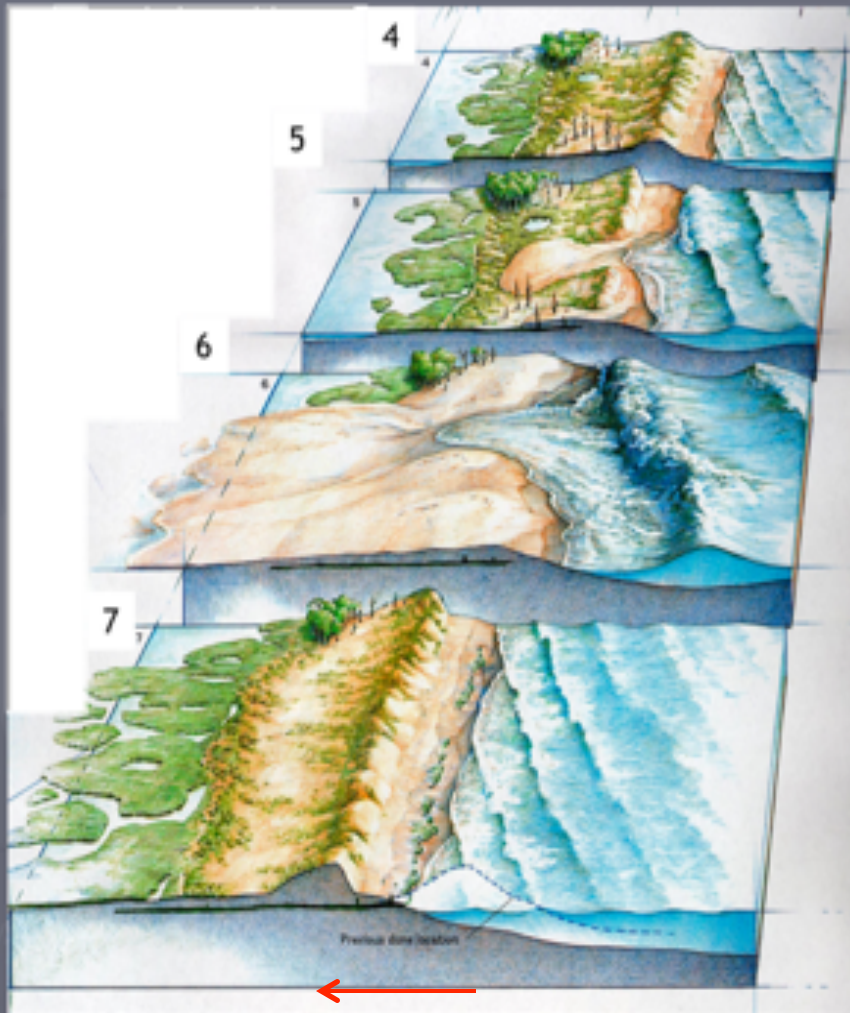
How our barriers and their beaches form:



National Geographic, 1997

1. Mainland spit expands
2. Spit is elongated by longshore transport of sand westward
3. Elongated spit is breached by storm waves, forming an island

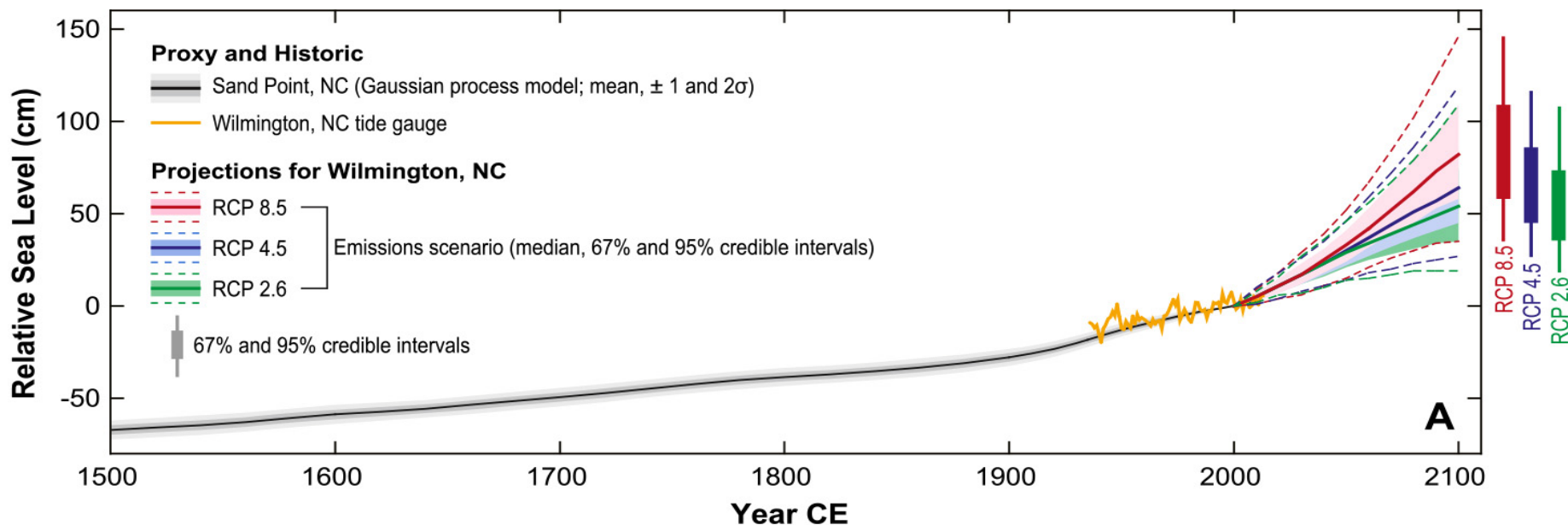
Barriers are Dynamic Systems



National Geographic, 1997

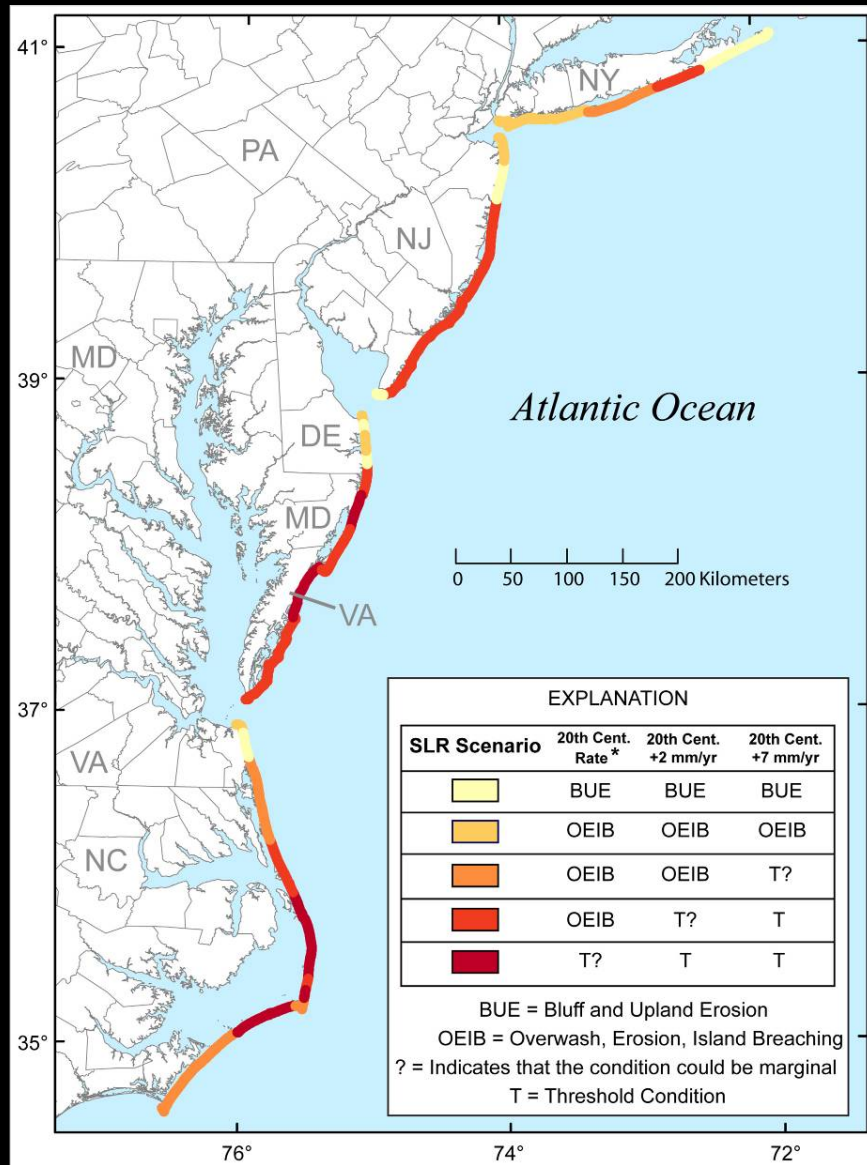
- 4. Sediment transported onshore builds up island beaches and dunes
- 5. Island overwashed by storm waves
- 6. Sediment transported through overwash buries vegetation
- 7. Island migrates landward

Sea-Level Rise in North Carolina



Kopp et al. 2015: Past and future sea-level rise along the coast of NC, Climatic Change, v. 132, p. 693-707.

Mid-Atlantic Assessment of Potential Dynamic Coastal Responses to Sea-level Rise



Bluff erosion



Overwash



Island Breaching



Threshold Crossing



Inlet formation: Isabel Inlet

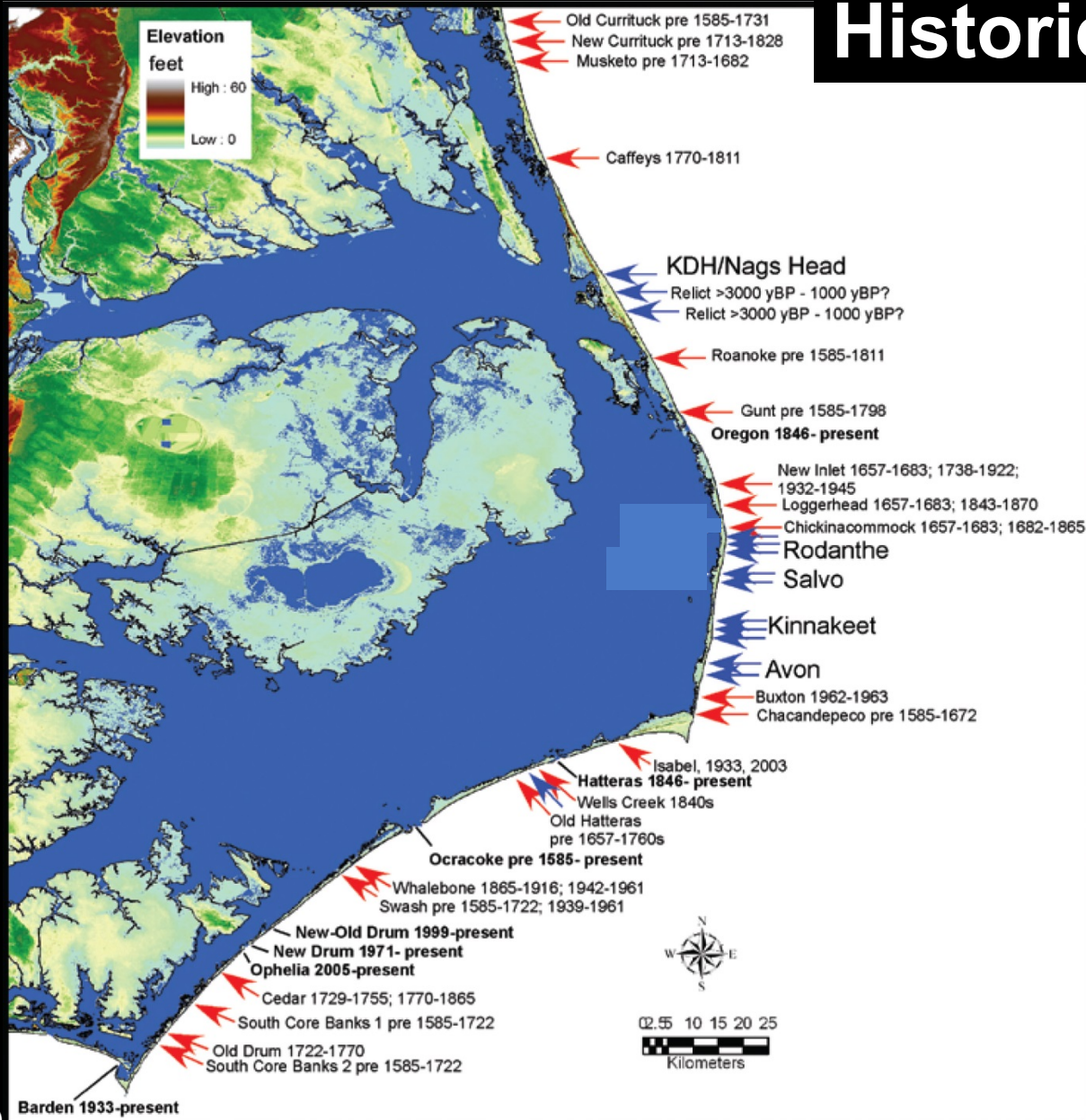
09/08/1999, Before



09/21/2003, After



Historical Inlets



From Figure 6: Mallinson et al., 2008, *Past, Present, and Future Inlets of the Outer Banks of North Carolina*.

Probability of Inundation

Cat. 3 Nor'easter



Cat. 1 Hurricane



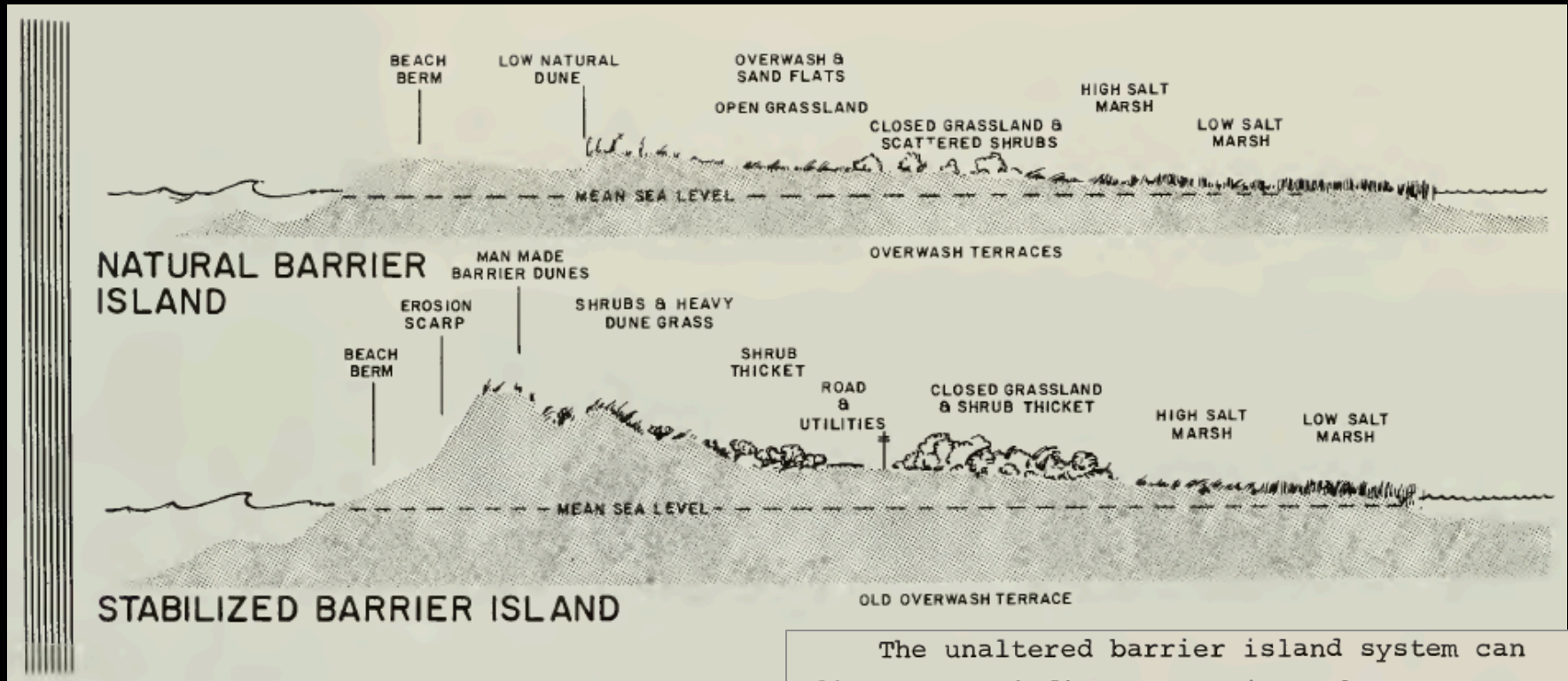
Cat. 3 Hurricane



Overwash



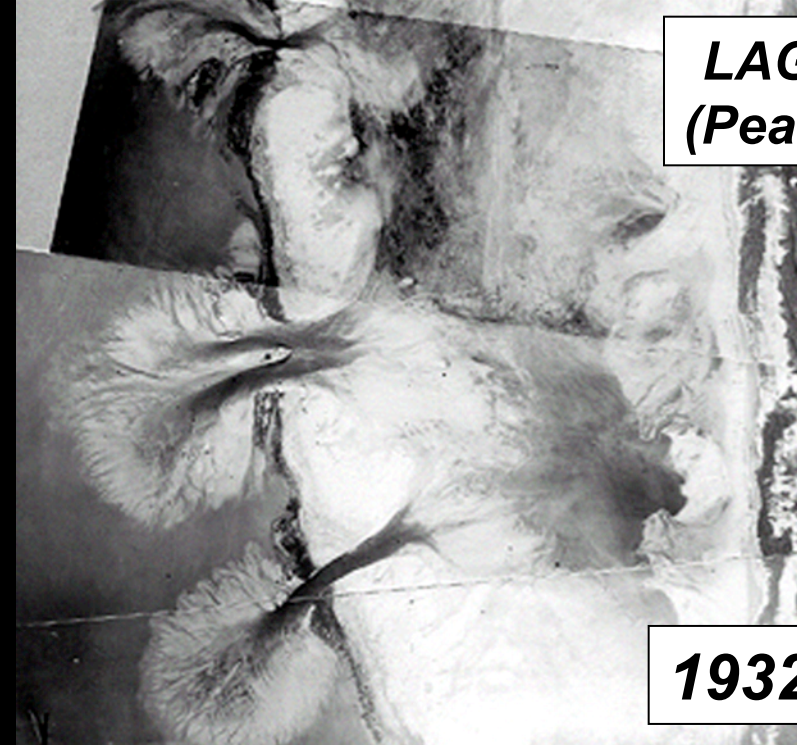
Anthropogenic modifications



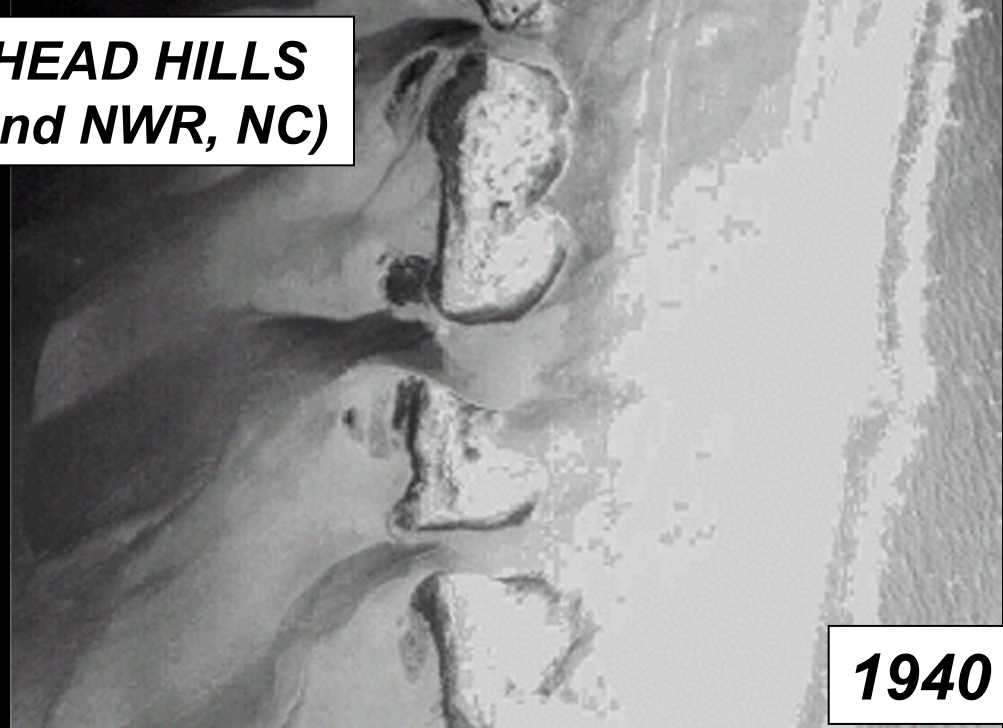
(Dolan, 1972)

The unaltered barrier island system can adjust to periodic storms since there are no natural obstructions in the path of the waves and surges. Most of the initial storm stress is sustained by the broad beaches. Because no resistance is created by impenetrable landforms, water flows between the dunes and across the islands with the result that energy is rapidly dissipated. On the sound side the fringes of marsh act as a buffer to reduce erosion from waves and surges generated on Core and Pamlico Sounds.

LAGERHEAD HILLS
(Pea Island NWR, NC)



1932



1940

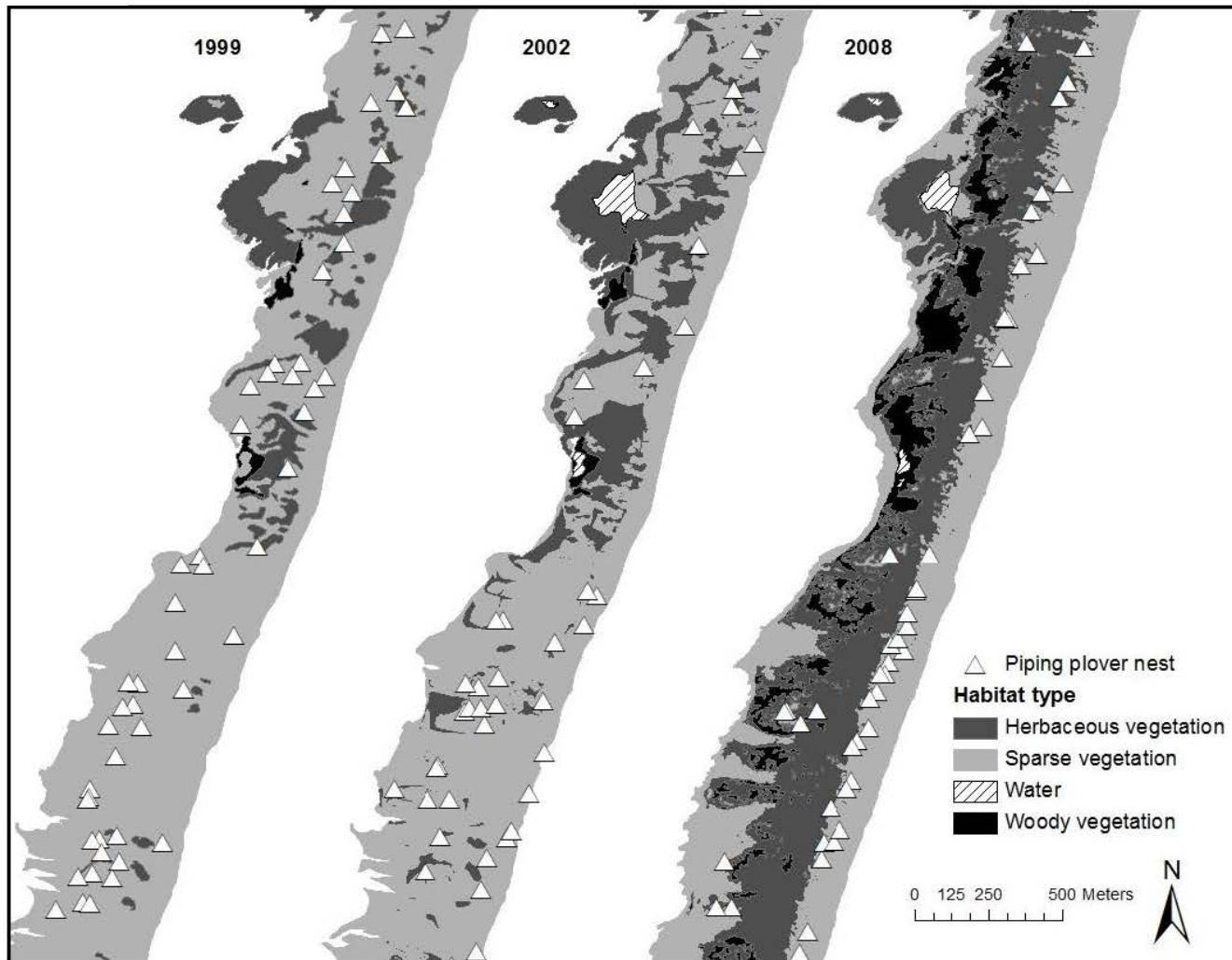


1962



1998

Overwash/erosion prevention altered habitat

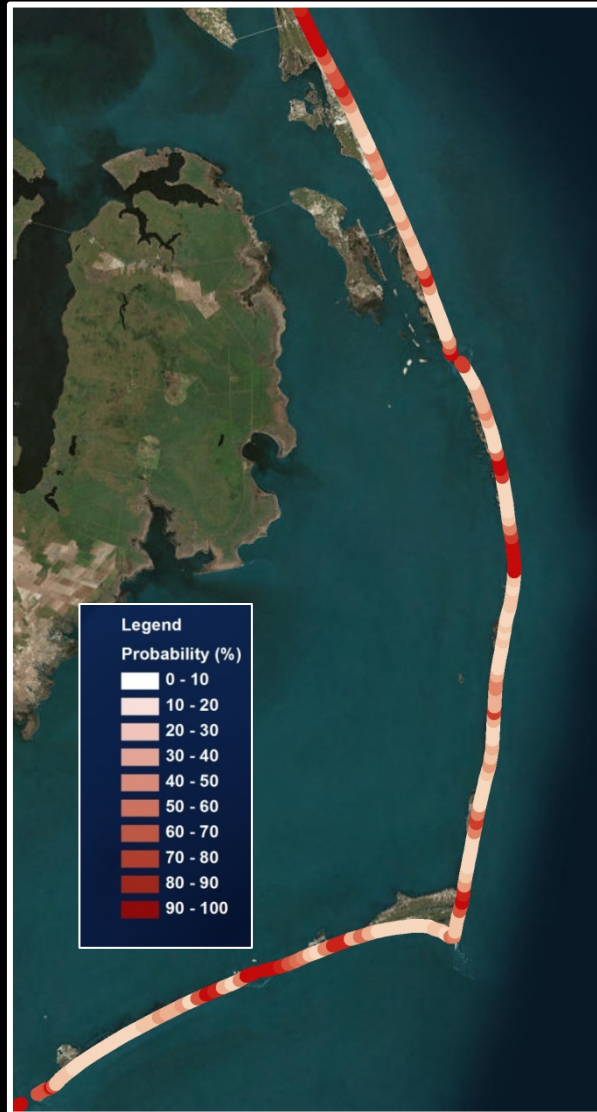


Probability of Overwash

Cat. 3 Nor'easter



Cat. 1 Hurricane

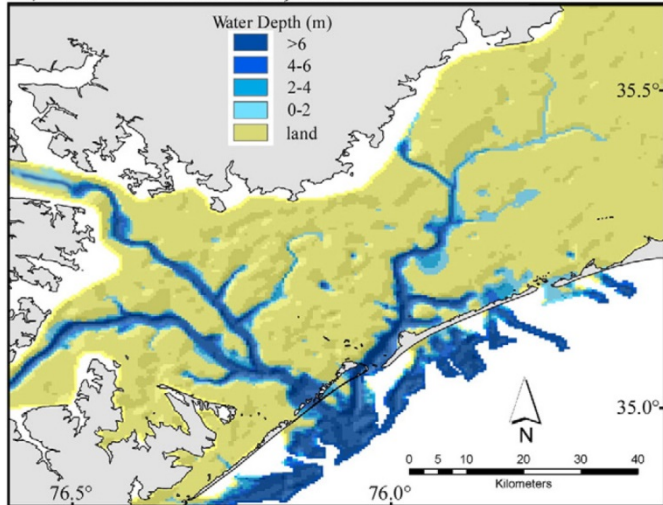


Cat. 3 Hurricane

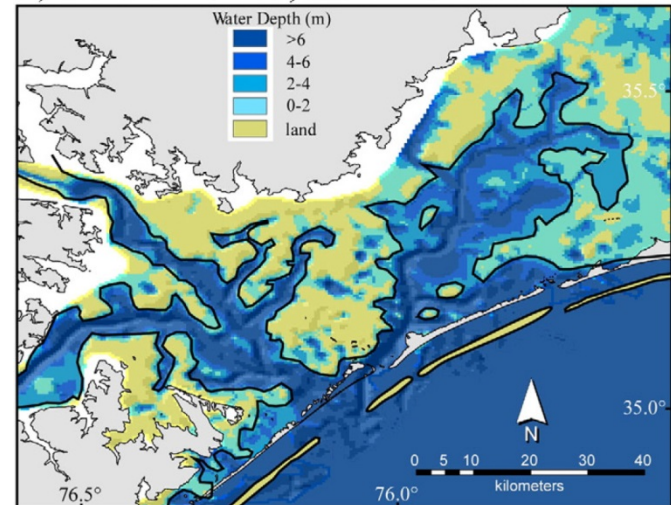


Geological Evidence of Past Coastal Change

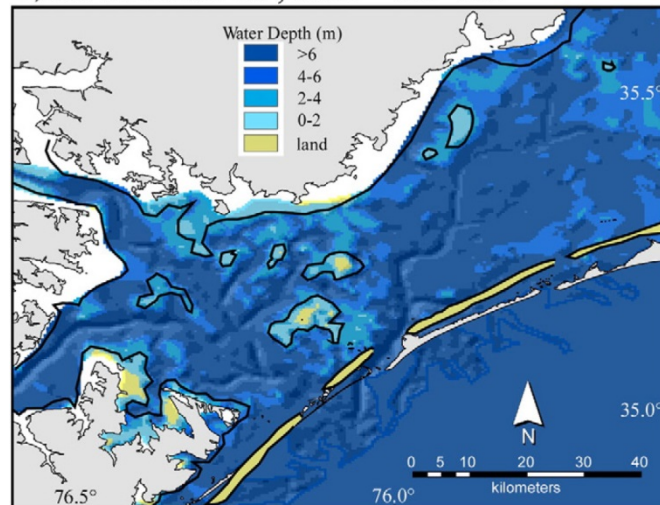
A) *ca.* 9500 cal BP; RSL = *ca.* -15m



B) *ca.* 7500 cal BP; RSL = *ca.* -10m

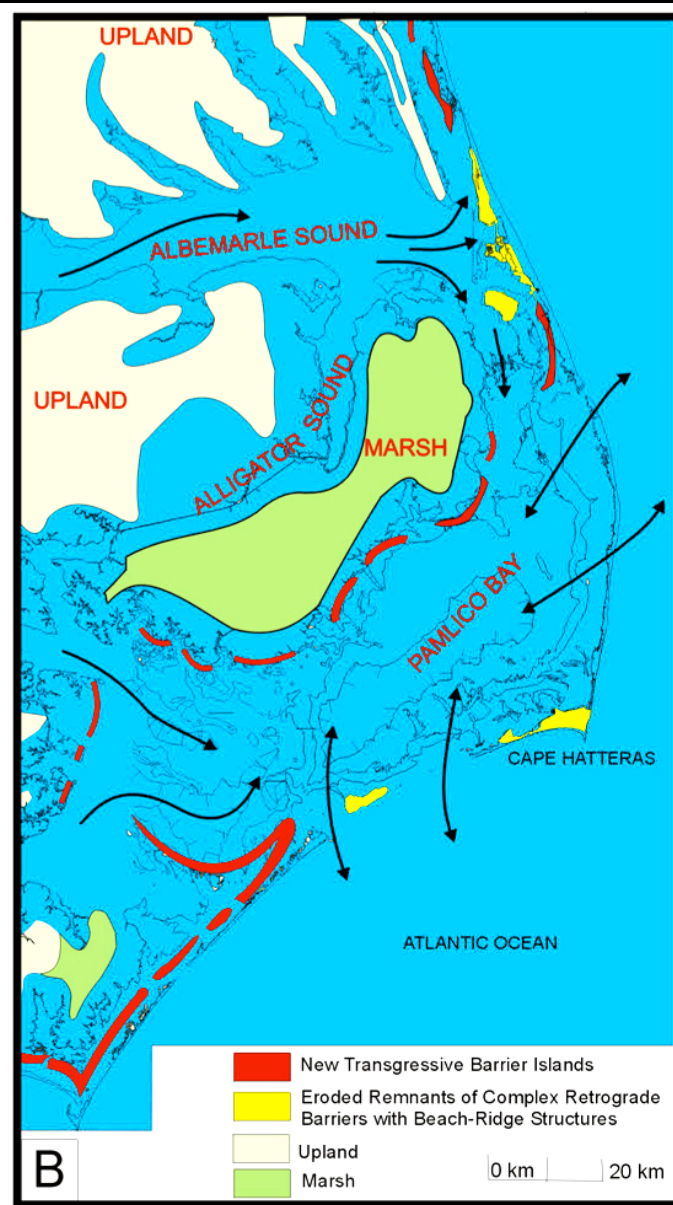
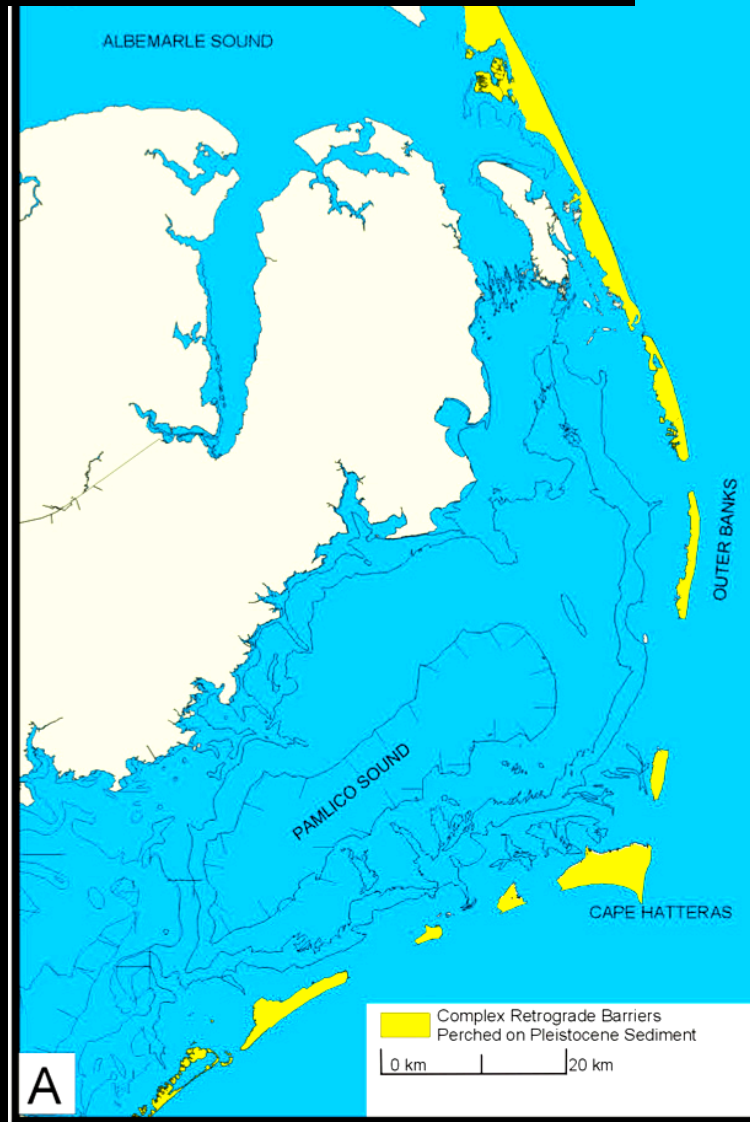


C) *ca.* 5000 cal BP; RSL = *ca.* -5m

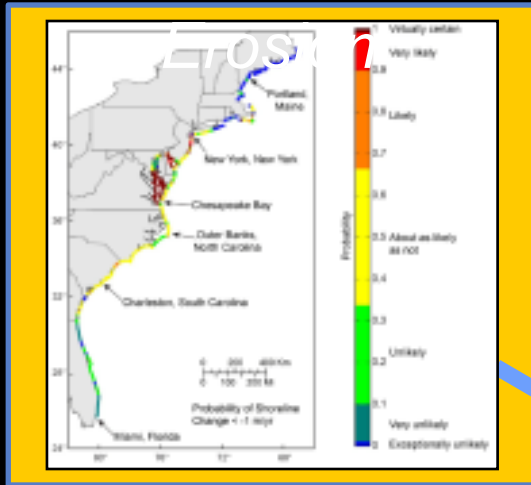


Zaremba et al., 2016

Future Conditions?



Sea-level Rise and Coastal



Evaluating and Forecasting Piping Plover Habitat

Barrier Island Morphology



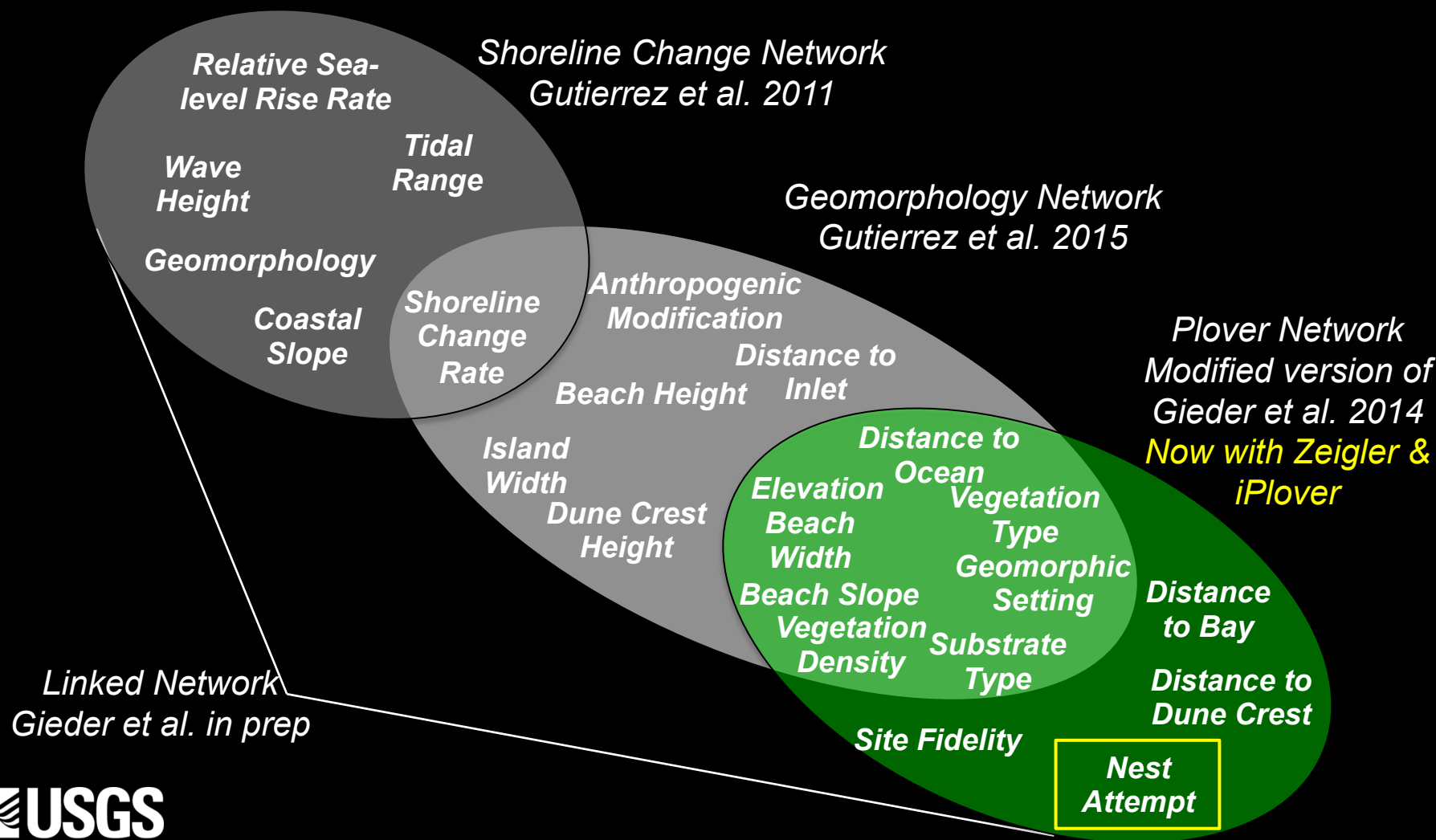
5-50 m scale

Habitat Suitability

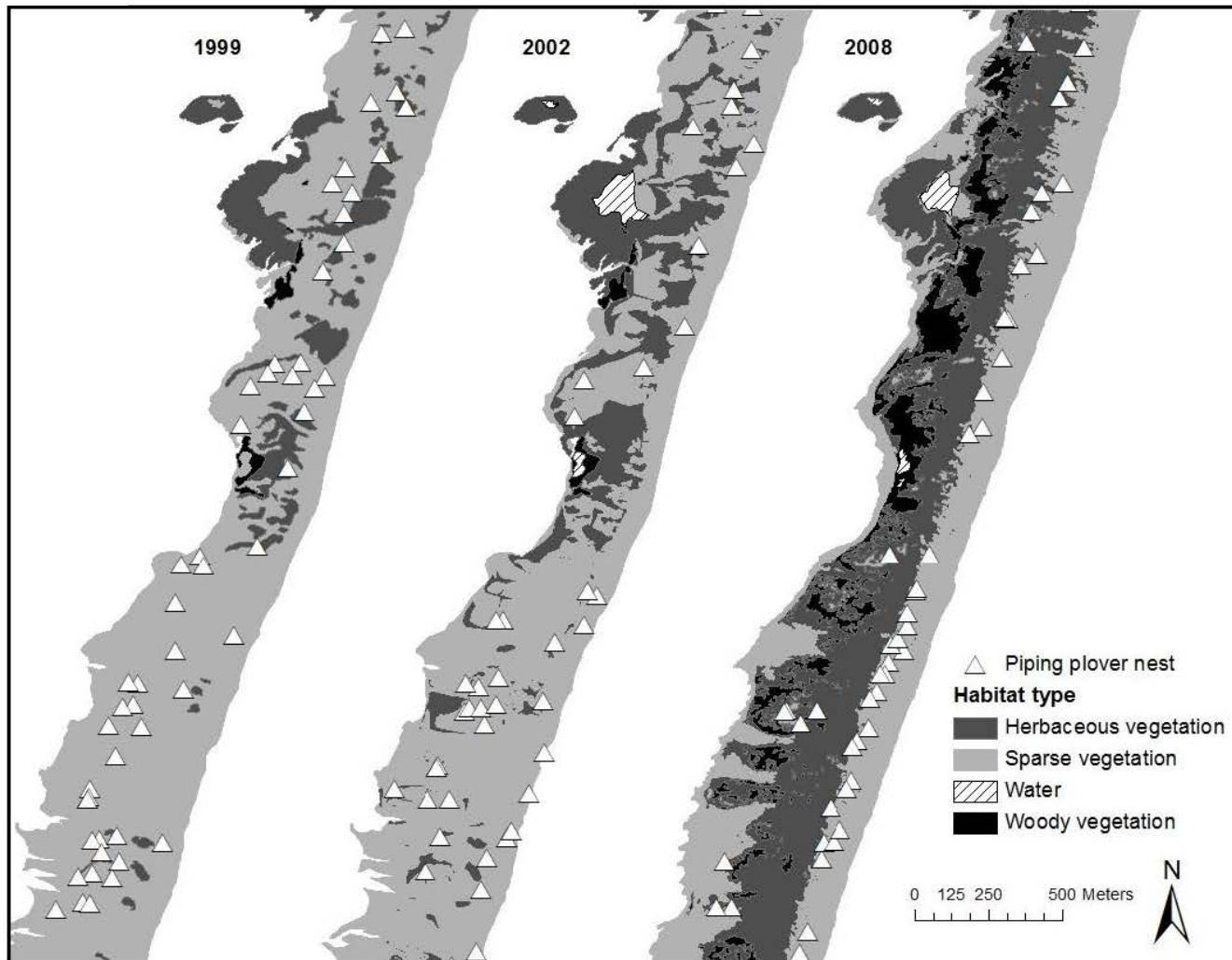


5 m scale

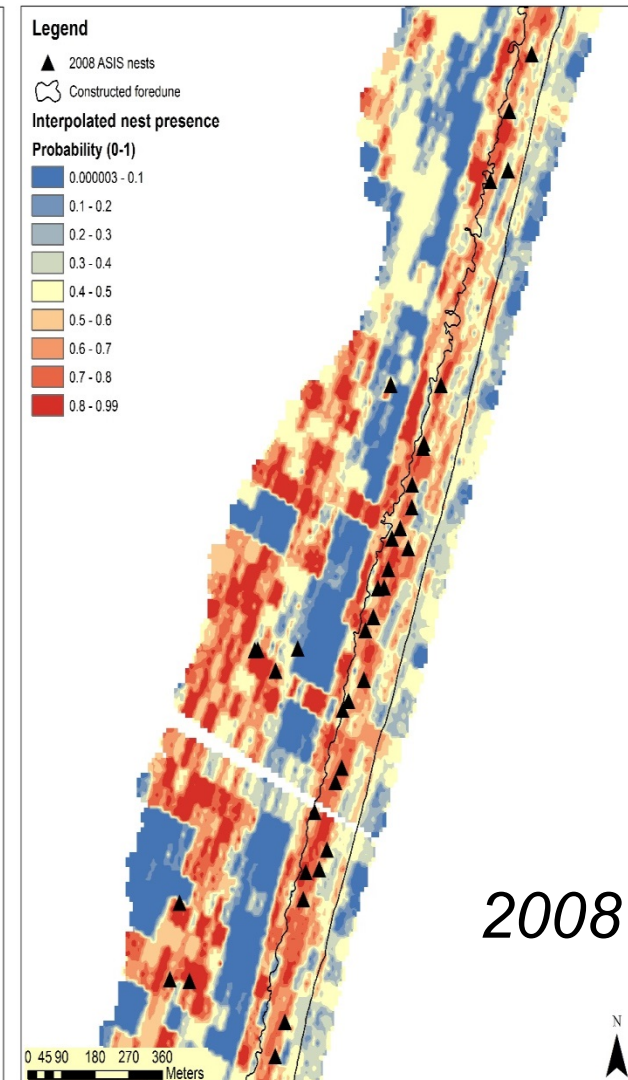
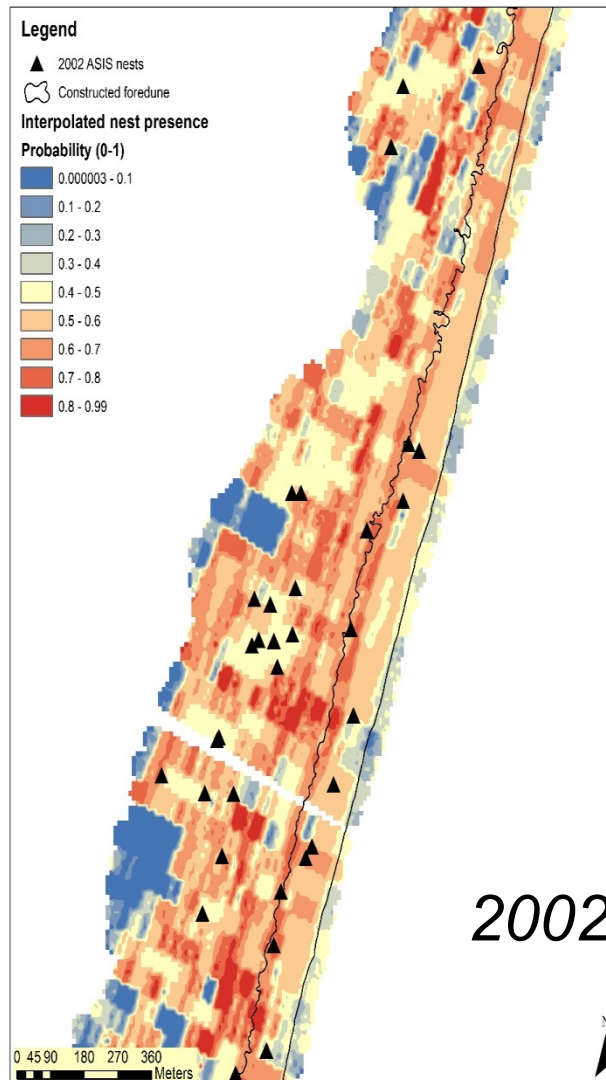
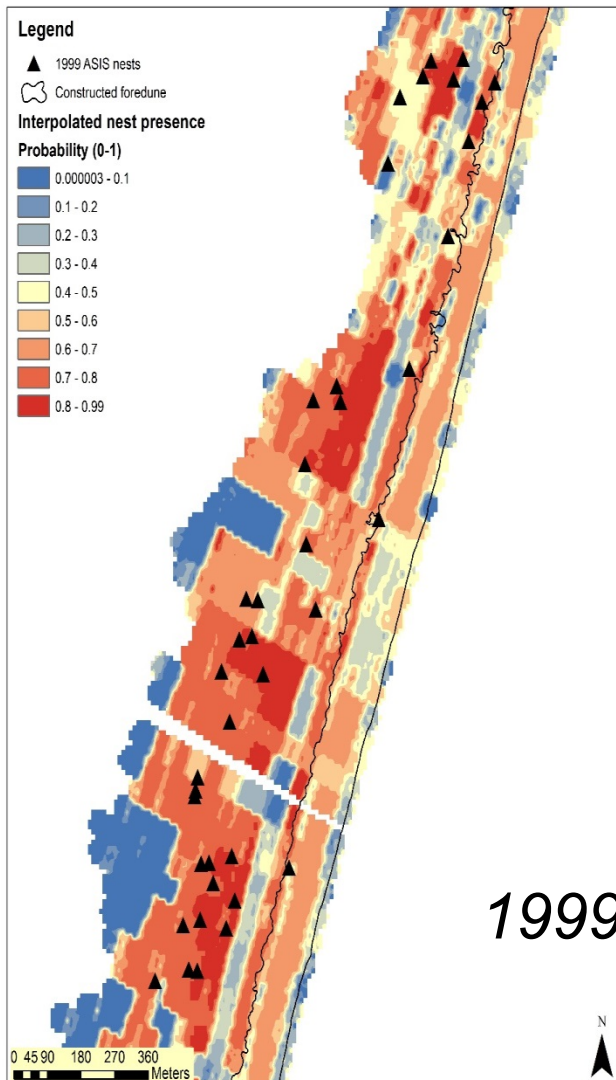
Forecasting the Effects of Sea-Level Rise on Piping Plovers



Overwash/erosion prevention altered habitat

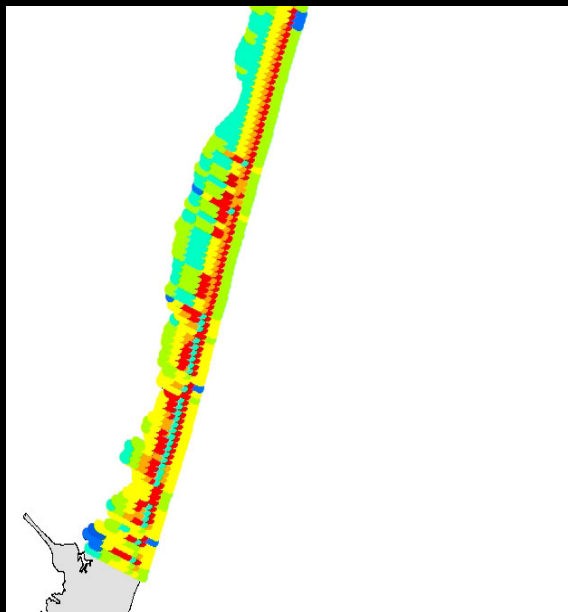


Evaluating Plover habitat suitability : North End ASIS 1999, 2002, 2008

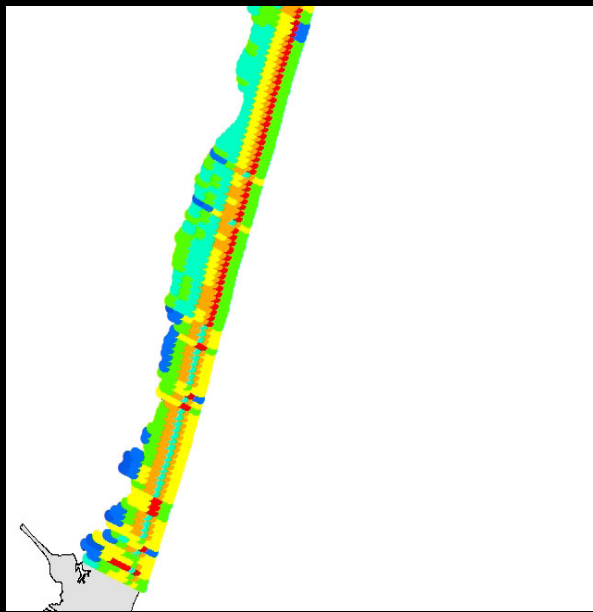


Linking BN Models to Forecast Future Habitat Suitability

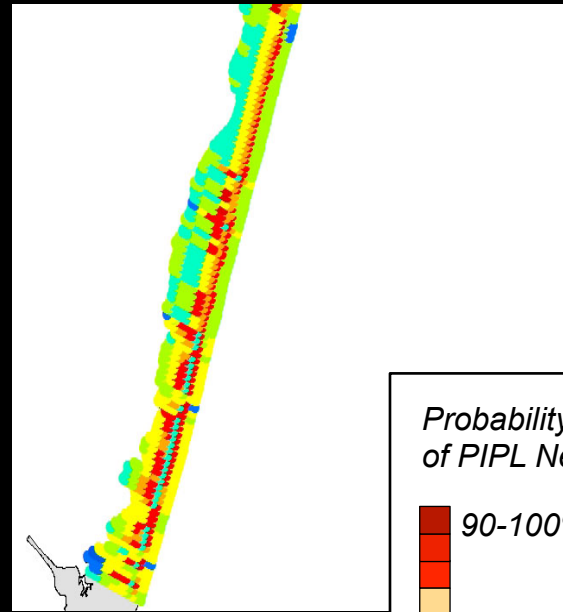
~2050, 4.1 mm/yr SLR



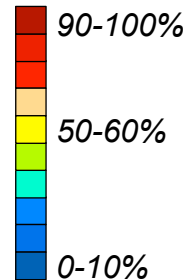
*~2050, 4.1 mm/yr SLR,
with frequent sand
placement*



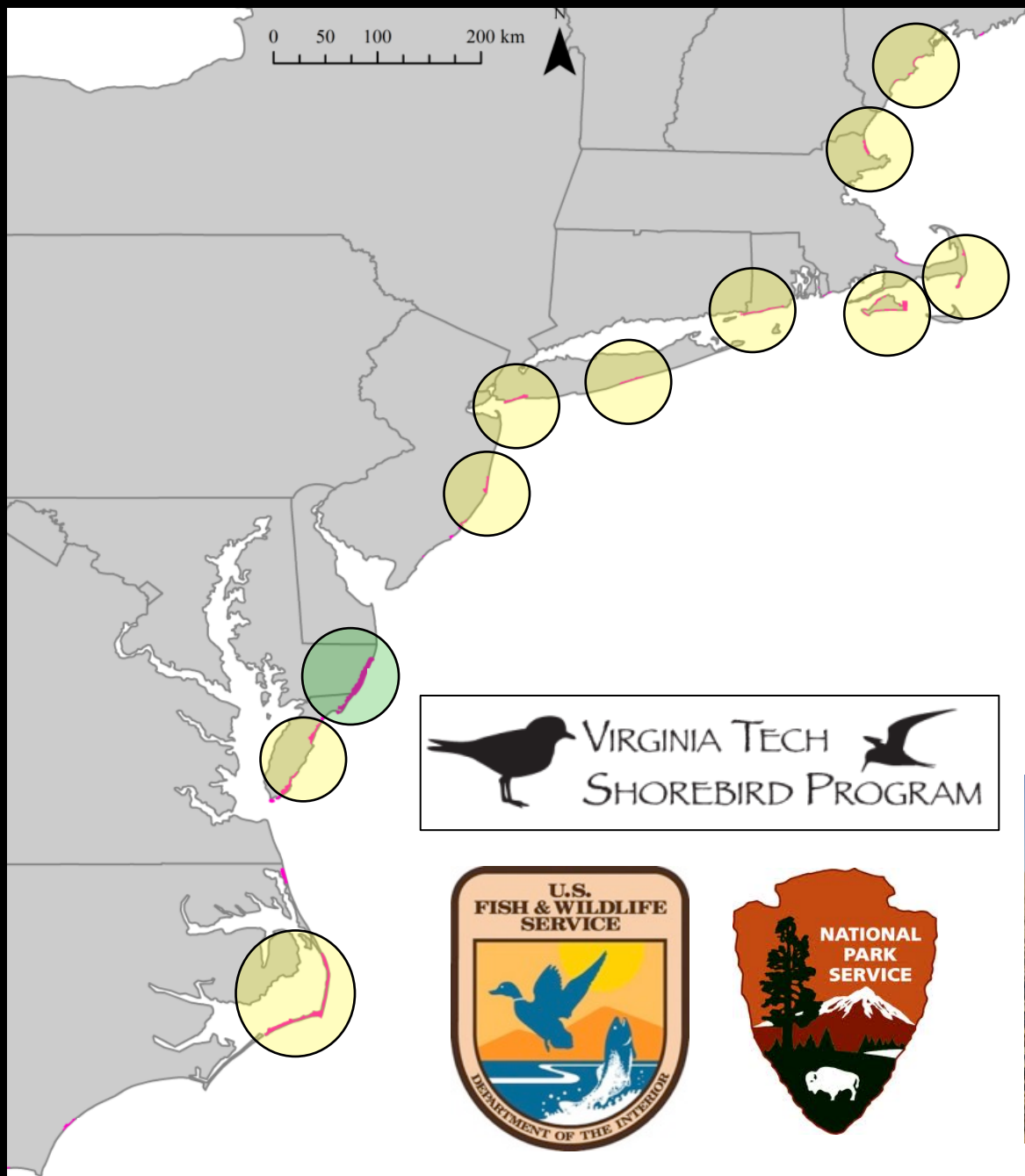
*~2050, 4.1 mm/yr SLR,
with increased berm
height & notches*



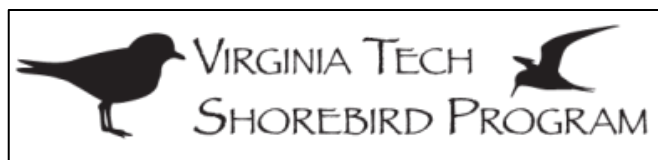
*Probability
of PIPL Nest*



(Gieder et al., in prep)



Identifying physical characteristics of shorebird habitat



Bill Byrne, MA Wildlife

Summary

Barrier island systems need overwash and inlets

Modifications that stop overwash and manage inlets impede naturally occurring changes

Infrastructure is dictating the response by reducing/ changing the processes required for healthy barrier system